DOCUMENT RESUME

ED 403 126 SE 059 454

TITLE	The University of Chicago School Mathematics Project, Autumn 1996.
INSTITUTION	Chicago Univ., IL. School Mathematics Project.
SPONS AGENCY	Amoco Foundation, Inc., Chicago, IL.
PUB DATE	96
NOTE	21p.
AVAILABLE FROM	University of Chicago School Mathematics Project, 5835 S. Kimbark Avenue, Chicago, IL 60637.
PUB TYPE	Reports - Descriptive (141)
EDRS PRICE	MF01/PC01 Plus Postage.
DESCRIPTORS	Academic Ability; *Educational Resources; Elementary Secondary Education; Instructional Materials; *Mathematics Curriculum; *Professional Development; *Relevance (Education); Student Evaluation; Telecommunications
IDENTIFIERS	*University of Chicago School Mathematics Project

ABSTRACT

This document discusses a variety of aspects of the University of Chicago School Mathematics Project (UCSMP). Extensive historical background of the project, including key personnel and funding sources at various stages, is provided. The goals of the project are to upgrade the mathematics experience of the average student, connect the real world with the mathematics curriculum, and garner international support for UCSMP. This report contains descriptions of the scope of the project; the UCSMP Online Service; the resource development component; the elementary and secondary components including materials development, teacher development, and evaluation; and a listing of available materials related to the different aspects of the project. Resources are also noted throughout the report that are appropriate for elementary and secondary mathematics instruction. (DDR)

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ED 403 126

UCSMP

The University of Chicago School Mathematics Project

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UCSMP Funding Sources

Amoco Foundation
supporting all components & project administration

National Science Foundation
supporting Elementary Materials & Teacher Development, Resource Development

Ford Motor Company
supporting Elementary & Secondary Teacher Development

Carnegie Corporation of New York
supporting Secondary Evaluation

General Electric Foundation
supporting Secondary Materials Development

GTE Corporation
supporting Primary Materials Development

Citicorp/Citibank
supporting Elementary Teacher Development

Exxon Education Foundation
supporting Elementary Teacher Development

UCSMP Secondary Curriculum Royalties
supporting Elementary & Secondary Evaluations, Administration

The University of Chicago School Mathematics Project

Zalman Usiskin, Director

UCSMP officially began in 1983 when, through the work of Izaak Wirszup at the University of Chicago and Keith McHenry of the Amoco Corporation, the departments of mathematics and education at the University received a generous six-year grant from the Amoco Foundation for a multifaceted project to improve mathematics education for the vast majority of students in grades K–12.

The project brought together several faculty whose research laid the groundwork for UCSMP. They were:

- Paul Sally, UCSMP's first director. Professor Sally had created special summer programs to teach higher mathematics to bright high school students and had taken a special interest in educating inner-city schoolchildren.
- Zalman Usiskin, UCSMP's current director and co-director of the Secondary Component. Professor Usiskin had researched the teaching of mathematics through real-life applications and had developed textbooks for all four years of high school incorporating contemporary mathematical thinking. His work had shown that many students enter high school with insufficient knowledge of arithmetic, algebra, and geometry to enable them to succeed.
- Max Bell, UCSMP's Elementary Component director. Professor Bell was a pioneer in the desire to teach applications of mathematics and had shown in his research that most children entered school with far greater mathematical knowledge than teachers and textbooks assumed.
- Izaak Wirszup, UCSMP's Resource Development Component director. Professor Wirszup had collected a vast library of educational materials and research from the Soviet Union and Eastern European countries, from which he had translated some of the best non-text materials. This work led him to alert senior government officials about the low standards of mathematics education in the United States compared to those in other countries.

Later, UCSMP would bring in as directors of portions of its work Sheila Sconiers, a 7th- and 8th-grade science and mathematics teacher who had worked with Professor Bell on developing materials for teachers; Larry Hedges, a professor of education with expertise in quantitative analysis and meta-analysis; Susan Stodolsky, a professor of education with expertise in qualitative analysis and classroom observation; and Sharon Senk, a professor of mathematics education who, before UCSMP began, had worked with Professor Usiskin on the development of geometry and proof.

UCSMP began by examining the curricula of other countries for proven ideas and methods, creating textbooks and training programs at both the elementary and secondary level, and engaging in extensive evaluations of its own work. Essential to this work was the participation of school administrators and teachers, who were closely involved in the planning, writing, and evaluation. Activities during this period were supported by grants from the first seven funding sources listed on page 2.

In 1989, recognizing the need for UCSMP to continue its work, the Amoco Foundation granted funding for five more years. This grant, followed by additional grants from the Carnegie Corporation of New York and the National Science Foundation (NSF), allowed the project to complete its K–3 materials, finish the last two books of its secondary curriculum, and continue work on its program for mathematics specialists in grades 4–6.

In 1992, the project undertook three new multiyear initiatives: the publication of UCSMP translations of foreign textbooks, the extension of the K–3 curriculum to grades 4–6 with the help of a five-year NSF grant, and the development of a second edition of the 7–12 curriculum.

The past year has seen the publication of *Sixth Grade Everyday Mathematics* by Everyday Learning Corporation and the second edition of *Geometry* by Scott Foresman/Addison Wesley. For educators and researchers, the American Mathematical Society (AMS) has published UCSMP translations of four Japanese texts for grades 10 and 11. UCSMP and its publishers continue to run conferences for teachers.

Work continues on an NSF-funded initiative to help implement *Everyday Mathematics*

and other innovative curricula by orienting teachers to recent changes in elementary school mathematics. Work is also being done on the second editions of *Functions, Statistics, and Trigonometry* and *Precalculus and Discrete Mathematics* to complete the second editions of UCSMP's 7–12 curriculum, an effort supported by royalties from Scott Foresman/Addison Wesley sales of the first editions.

The most fundamental feature of UCSMP is its focus on upgrading the mathematics experience of the average student.

These royalties also generate funds for research in mathematics education—for UCSMP evaluations and other university research on teaching and learning mathematics.

Upgrading the School Mathematics Experience for the Average Student

Why has UCSMP undertaken such a massive effort, and why have so many supported us? One reason is that the information explosion and advances in technology have widened the scope and multiplied the methods of applied mathematics. More and more, mathematical ideas are important to the activities and well-being of the average citizen.

Improving the current situation requires effort at all levels from kindergarten through college. The typical first-grade student today can expect to work through the first half of the next century. Yet in many American schools, this student still encounters a variant of the elementary school curriculum designed for the pupil of a hundred years ago. The secondary curriculum in many schools is likewise out of date, with almost all of its content oriented towards calculus, ignoring the vast majority of students who either will not take calculus or require preparation for other college mathematics as well. At all levels, curricula need to be modified to take advantage of today's widely available technology.

Teaching in the elementary grades often illuminates only one band of the mathematical spectrum, calculation. Even where students receive other mathematics instruction, the curricula do not expect competence or fully develop the concepts presented. In contrast, the UCSMP *Everyday Mathematics* curriculum encourages teachers and students to explore more of the spectrum by investigating, informally but systematically, the basics of data gathering and analysis, probability, geometry, and algebra, and by taking advantage of the young child's ability and desire to explore and learn.

Most primary teachers, though willing to take students as far as possible with language arts and reading, feel insecure about stretching students' mathematical experiences. A mathematics-rich atmosphere in the classroom is possible, but requires sensitivity to the subject and knowledge of a variety of pedagogical tools. UCSMP's *Everyday Teaching for Everyday Mathematics* gives K–3 teachers breadth of mathematics knowledge and a full complement of instructional strategies. A more extensive program for grades 4–6 concentrates on upgrading teachers to become mathematics specialists.

A major UCSMP strategy has been to even out the pace of instruction. In the past, seventh- and eighth-grade mathematics courses offered only counterproductive, dulling review. Although some might feel the UCSMP secondary curriculum accelerates students, it is more accurate to say that it avoids deceleration. The first course, *Transition Mathematics*, is designed for students at the seventh-grade level mathematically, regardless of age; it consolidates the arithmetic of previous grades while preparing students for the next two courses, *Algebra* and *Geometry*. The fourth course, *Advanced Algebra*, should be taken by all who graduate high school. Those who will attend college need *Functions, Statistics, and Trigonometry* to prepare them for the wide range of mathematics found in virtually all college majors today. *Precalculus and Discrete Mathematics*, the final course, covers the content and mathematical thinking that mathematical and physical science majors and engineers require. With a strengthened K–5 curriculum, increasing numbers of students are starting this curriculum in sixth grade and taking advanced placement courses.

The Real World and the Mathematics Curriculum

Another reason for UCSMP's work is to counter the practice of many existing mathematics courses, which avoid the real world and use instead contrived word problems. Real data are virtually absent.

In contrast, applications are a hallmark of all UCSMP materials. Project curricula explore the questions many students ask: "How does this relate to the world I know? How can mathematics help me understand my world and what people do?" All UCSMP materials view and teach mathematics as a tool for life. Elementary-level materials explain how teachers can integrate mathematics with other subjects, sensitizing teachers to seize opportunities for thinking mathematically throughout the school day. And at the secondary level, applications abound. The reading in lessons highlights these applications and introduces students to the history and cultural presence of mathematics.

The real world affects process as well as content. In some traditional classrooms, students learn one way to do a problem and are prohibited from using the tools that might make solving it easier. On the job, the opposite occurs: the goal is to be flexible, to consider many ways to accomplish a task, and to use the best tools available. For this reason, UCSMP is committed to using calculators and computer technology. The calculator and computer affect not only the approaches to content, but also content itself. Some topics are no longer essential; other topics become accessible to more students; still other topics must enter the curriculum. Evidence from UCSMP evaluations and from the research of others shows that the appropriate use of technology enhances students' mathematical understanding and improves problem-solving skills.

Beginning in kindergarten, therefore, we encourage the use of four-function calculators to explore mathematical concepts. In the fourth through sixth grades, separate time for calculator work is no longer necessary, and students should use calculators at their own discretion. By the seventh grade, students need scientific calculators because common numbers are often too big or too small to be handled by simpler calculators. Beginning with UCSMP *Algebra*, we recommend the use of graphing calculators. Automatic graphers are required for the last two secondary courses in the first edition, and the last three in the second edition.

With adequate software, the computer solves problems and allows teachers and students to consider variations on a problem, to test conjectures, to process a large amount of data, and to graph in a variety of modes. Software that supports UCSMP's secondary-level courses is available from Scott Foresman/Addison Wesley.

Support Within UCSMP

A project of this magnitude requires many ideas. From its inception, UCSMP has scoured the world for the best ideas available. By surveying and translating materials from Europe and Japan, UCSMP has broadened its perspective regarding what can be done in the classroom. This work raises the proficiency levels we think students can achieve, for it is clear that foreign educators (and parents) work from the premise that mathematical success is based more on opportunity to learn, interest, and diligence than on ability, and that the abilities of most students do not differ enough to warrant a different curriculum.

These ideas and beliefs need to be communicated to a broader audience. To this end, the Resource Development Component sponsored international conferences in 1985, 1988, and 1991. UCSMP translations and a large collection of foreign materials are accessible for scholarly research through the International Mathematics Education Resource Center. Some translations have been published (see p. 19).

From its inception, UCSMP has scoured the world for the best ideas available.

Other countries look to the United States for leadership. No curriculum in any country is perfect, and changes in mathematics and its uses have occurred worldwide. Our attention to applications and technology has generated great interest in the project throughout the world.

As schools and educators look to UCSMP for leadership, we realize the importance of self-examination. Evaluation has been integral to UCSMP from the start, providing a regular source of feedback. UCSMP evaluators use the latest qualitative and quantitative methods to assess the impact and implementation of project curricula. Rather than assume that students and teachers work with the materials uniformly and according to project intentions, evaluators examine actual use. Studies focus equally on the unique characteristics of classes, schools, and

districts, and on broader generalizations about the effectiveness of project programs.

While curriculum materials are being developed, evaluations are formative. They indicate how we are doing and where we need to improve. After the materials are final or near-final, evaluations demonstrate the achievement differences educators can expect from UCSMP materials and ideas. These evaluations then become available to the public.

Since 1983, we have seen many of our beliefs accepted by the education community. Still, much work remains to be done.

How Far Have We Come?

In 1996–97, we estimate that over three million students are using UCSMP elementary and secondary materials; teachers of many other students, along with teacher educators, have participated in UCSMP teacher development programs or attended our conferences.

It was never UCSMP's goal to create a national curriculum. No project should aim for such a goal. We need a diversity of ideas to enable us to improve what we do, and the work of everyone involved in schooling is required to implement change on the necessary scale. Our goal continues to be the creation of exemplary models and materials that will challenge others to work to improve school mathematics in grades K–12.

Change does not occur quickly, but since 1983 we have seen many of our beliefs accepted by the education community. Applications have become a feature of most course materials at all levels from K–12. When we began, we were bold in requiring calculators in our courses; now calculators are a mainstay in most secondary school classrooms. That all children can learn significant amounts of mathematics is now a widely held belief. And in many schools the curriculum in grades 7 and 8 is no longer concerned primarily with review; national data suggest that since 1981 the number of students taking a full algebra course in eighth grade has approximately doubled.

UCSMP has also influenced national policy. We had a hand in creating the Mathematical Sciences Education Board, and our work influenced the standards established by the National Council of Teachers of Mathematics (NCTM). After some fifteen years during which curriculum projects were thought not to influence what goes on in more than a handful of schools, the existence and wide use of UCSMP materials encouraged NSF to fund a dozen multiyear projects at all levels from K–12 (including our own 4–6 curriculum efforts). Last year, we hosted the Gateways Conference, bringing together these projects.

Still, much work remains to be done. There are very few specialist teachers in elementary schools, and the mathematical preparation of most elementary school teachers is pitifully weak. Many educators still view the developments of recent years as a fad, and they are waiting for it to pass. We must be especially concerned about urban public schools because, as before in the history of U.S. education, they are changing with the times more slowly than suburban and small-town public, private, and parochial schools. Those who do not keep up now are likely to be even further behind when the next changes come.

UCSMP Online

Getting in touch with the project...

To inquire about project activities or materials, you may contact the UCSMP office directly.

- e-mail **ucsmp@cicero.uchicago.edu**

Getting in touch with other UCSMP users...

To subscribe to the UCSMP forum and receive all of its messages

- e-mail **ucsmp-request@spclists.spc.uchicago.edu**
- type the word **subscribe** in the body (not the subject line) of your message

To participate in the forum once you are a subscriber

- send messages to **ucsmp@spclists.spc.uchicago.edu**

Resource Development Component

Izaak Wirszup, Director

By translating outstanding school mathematics publications from around the world, the UCSMP Resource Development Component offers a first-hand look at expectations, approaches, and methodologies differing from those in the United States. Primary school texts and workbooks from the former Soviet Union, for example, introduce multidigit numbers, variables, and equations, together with an abundance of word problems, starting in grade 1 (our grade 2); by mandate, intuitive geometry comprises at least 20% of the mathematics curriculum in grades 1–5. The spectacular achievement of elementary and secondary school students in Japan led UCSMP to translate a major Japanese textbook series. In addition to translating foreign publications, the Resource Development Component monitors the latest international literature on mathematics education, has organized international conferences, and maintains an International Mathematics Education Resource Center. What UCSMP has learned of mathematics education and achievement standards in other countries challenges Americans to expect more of our own students and has been a valuable resource for developing UCSMP materials.

Translation and Publication of Foreign Mathematics Education Materials

For the first time in 1992, UCSMP translated and made available a number of foreign materials, including three Japanese textbooks for grades 7–9, three Russian textbooks for grades 1–3, and two Russian research monographs. In addition, as a result of an agreement between UCSMP and AMS, in 1996 AMS published the following UCSMP translations as part of its "Mathematical World" series: *Mathematics 1: Japanese Grade 10*; *Mathematics 2: Japanese Grade 11*; *Algebra and Geometry: Japanese Grade 11*; and *Basic Analysis: Japanese Grade 11*. These books (and the texts for grades 7–9 published by UCSMP) are part of the leading high school series in Japan, edited by Kunihiko Kodaira, Professor Emeritus of Mathematics at the Institute for Advanced Study in Princeton. All the books reflect Japan's sophisticated national curriculum. In the future, we hope to publish more of our translations.

These publications are among more than 40 outstanding mathematics textbooks, including the entire compulsory curriculum of the former Soviet Union, translated by the Resource Development Component. The Russian materials comprise standard textbooks for every grade level, as well as supplements for both teachers and students.

Other elementary textbooks and workbooks from Bulgaria, Czechoslovakia, Germany, and Hungary have been translated. These texts feature a lively presentation coupled with different emphases, such as coding and histograms in the Bulgarian books and combinatorics in the Hungarian texts. The component's translations are accessible to a wider audience through the International Mathematics Education Resource Center (see p. 8).

The component translated the 200th issue of *Kvant*, a popular monthly Soviet mathematics and physics magazine for secondary school students (grades 6–10). Founded in 1970, *Kvant* is published by the Russian Academy of Sciences and the Russian Academy of Pedagogical Sciences. Following UCSMP's translation, in 1989 the National Science Teachers Association and Quantum Bureau of the Soviet Academy of Sciences, with the American Association of Physics Teachers and NCTM, began joint publication of a bimonthly English-language version of *Kvant*, which is entitled *Quantum*.

Survey of Foreign Mathematics Education Literature

In cooperation with the NSF-funded Survey of Applied Soviet Research in School Mathematics Education (1985-91), UCSMP has translated and published leading Soviet research in the psychology and methodology of mathematics education, material previously unavailable in the United States. The first six translations in the new series "Soviet Studies in Mathematics Education" were published in 1991 by NCTM; two additional volumes were published in 1992

by UCSMP. These studies continue to have applications both within UCSMP and in mathematics and science curriculum initiatives elsewhere.

The library of the NSF Survey of Recent East European Mathematical Literature (1958-83) was available to the project at its outset. The collection has since expanded to include similar publications from Belgium, France, Germany, Great Britain, Israel, Japan, and Sweden.

The Resource Development Component continues to monitor foreign journals and research monographs for significant developments in mathematics education around the world. Awareness of foreign successes and innovative approaches is essential if American mathematics education is to be competitive with the best foreign programs.

International Conferences on Mathematics Education

The component has organized three UCSMP International Conferences on Mathematics Education. Held in 1985, 1988, and 1991, each featured prominent U.S. and foreign mathematics educators. NCTM published the proceedings of these conferences in three volumes titled *Developments in School Mathematics Education Around the World.*

The first conference focused on applications-oriented curricula and innovative instructional strategies, and the second conference on school mathematics reform and national standards in France, Great Britain, Japan, Sweden, and the United States.

The proceedings of the third conference appeared in 1993, comprising 31 papers by leading scholars from the United States, Brazil, Canada, the People's Republic of China, Denmark, France, Germany, Great Britain, Israel, Japan, the Netherlands, and Sweden. The volume is organized into four sections discussing the goal of mathematics for all, analyzing historical and contemporary reforms, examining current projects and proposals for reform, and making international comparisons.

Proceedings from all three conferences have been distributed internationally and are frequently cited in the United States and abroad. These volumes represent some of the best thinking of the mathematics education community worldwide and are a valuable resource for American scholars and teachers, especially those interested in setting world-class school mathematics standards.

International Mathematics Education Resource Center

In 1988, the Resource Development Component opened a unique center to house the UCSMP translations, to complement the two NSF surveys kept elsewhere on campus. The purpose of the three collections is to help U.S. education leaders further improve mathematics and science instruction. The International Mathematics Education Resource Center serves as a permanent exhibit, clearinghouse, and research facility containing original and translated materials related to school mathematics, offering access to a broad range of hard-to-find foreign sources and providing research assistance to visitors.

Holdings of the three collections include the following:

- **Russian-language publications** in mathematics and science education and educational psychology. This collection comprises textbooks and workbooks, teacher's manuals, teacher training materials, extracurricular literature, and research monographs in mathematics education and psychology. It was assembled primarily by the two NSF surveys. Also available are 57 published survey translations of outstanding Soviet materials; additional unpublished translations may also be examined.

- **All UCSMP translations** of mathematics textbooks, workbooks, and teacher's manuals from the former Soviet Union, Japan, Bulgaria, and Hungary.

- **Some 500 recent mathematics textbooks** from Belgium, Bulgaria, Czechoslovakia, Germany, France, Great Britain, Hungary, Japan, Poland, and Sweden, selected from the NSF survey collection.

The center is continuously expanding its holdings. It has hosted teachers, scholars, and graduate students from all over the nation and several foreign countries. Those who wish to visit the center may set up appointments by writing to the director of the component.

Translations and other documents are available as indicated on page 19.

Elementary Component

Max Bell, Director

Materials Development

UCSMP began developing its elementary curriculum in the summer of 1985 by working with teachers on the material that became *Kindergarten Everyday Mathematics*. By then, the need for richer curriculum resources had been made clear by the results of our studies of K–3 children in a broad range of schools. These results clearly showed that the early school mathematics experience in the United States ignored many of the actual capabilities of young children. At the same time, reports from international studies showed U.S. students learning much less mathematics in grades K–6 than students in many other countries.

Principles for Building a New Curriculum

Research with children and teachers led us to a number of principles for developing the *Everyday Mathematics* curriculum:

- **From their own experience** children construct an understanding of mathematics and acquire knowledge and skills. Teachers and other adults are a very important part of that experience.
- **Children begin school** with quite a lot of knowledge and intuition on which to build. One important task for the K–6 curriculum is to help children make the gradual transition from intuition and concrete operations to abstractions and symbol processing skills.
- **Excellent instruction** is very important. It should provide rich contexts and accommodate a variety of learning styles.
- **Reforms often fail** because they do not take into consideration the working lives of teachers. The new curriculum should be practical and manageable, and it should include suggestions and procedures that make teachers' lives easier, at least in the long run.
- **The new curriculum** should include practical routines to help build the arithmetic skills and quick responses that are essential for building number sense, estimation skills, and flexibility in a problem-rich environment.

The structure of the UCSMP curriculum is that of a helix (three-dimensional spiral), with every important concept or skill recurring with variations throughout the curriculum. Hence, our development principles include a *two-year rule* (e.g., anything dealt with seriously in grade 3 has been introduced by grade 1) and a *five-exposures rule* (once introduced, a concept is revisited in at least five different ways, each with considerable practice).

Thinking with mathematics becomes as natural as thinking with language.

Features of Everyday Mathematics

The *Everyday Mathematics* curriculum establishes a framework for dialogue about mathematics between teachers and children and among children themselves. Thinking with mathematics becomes as natural as thinking with language. Calculators are an integral part of the program as an aid to concept development and applications. Estimation and a variety of strategies for problem-solving are emphasized throughout.

The curriculum assumes that each child has a slate, a calculator, measuring tools, and drawing tools, and that each teacher has a classroom set of manipulatives. This requires an initial investment, without which genuine reform cannot be successfully implemented.

Kindergarten Everyday Mathematics

The first year of the curriculum supports about 100 hours of mathematics activities. The program emphasizes playful, verbal interactions and manipulative activities while laying the

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groundwork for symbolic understanding. The activities encompass a variety of mathematics strands, including simple and complex counting, numeration, operations, measurement, geometry, clock and calendar use, graphs, patterns, attributes, and function ideas. Common-life applications are a feature of each strand. *Kindergarten Everyday Mathematics* includes these parts:

The **Teacher's Manual and Lesson Guide** presents the core of the program. In addition, it suggests a variety of ongoing daily routines, to be carried out mostly by the children, which offer many opportunities for teaching meaningful mathematics. Children keep daily attendance and weather records, maintain a job chart and daily schedule, and are involved in a variety of daily activities, including counting, numeration, measurement, geometry, data collection and display, money, operations, time, patterns, and sequences.

Minute Math offers many suggestions for "fillers" for odd moments of the day. Activities parallel and reinforce the Lesson Guide activities. They present much of the problem-solving strand of the program as brief verbal problems.

A set of **Student Activity Aids** provides games and other playful activities in support of the lessons.

Kindergarten Home Links is a series of booklets (in English and Spanish) sent home three times during the year with many suggestions for playful activities related to the curriculum that parents can do with their children.

Everyday Mathematics for Grades 1–3

Materials for grades 1–3 build on and extend the concepts begun in the preceding grades, with progressively increasing attention to mental and symbolic arithmetic, measurement, geometry, the collection and use of data, and the beginnings of algebra. Strong emphasis is placed on formulating and solving "number stories" with information from day-to-day life, science, geography, and other curriculum areas.

Each course provides complete teacher guides and student materials for a full year of work. Every curriculum package has four parts:

The **Teacher's Manual and Lesson Guide** includes these main components: 1) daily **lesson plans** supporting the program's mathematics strands; 2) a **reference** on mathematics and the program for first-time users and for consultation by experienced users; 3) **explorations and projects** that support the mathematics strands and also include cross-curricular work in science, health, geography, and other areas; 4) **math boxes** to provide continuous review of concepts and skills; 5) **blackline masters** for reproducing forms, reports, and letters.

Minute Math Plus provides more of the kinds of activities described for kindergarten.

Student Materials include student journals, *Numbers About Me* and *Numbers In My World* booklets, and books of activity sheets.

Home Links provides for follow-up and enrichment activities that may be done with someone at home.

An assessment booklet, a bridging module (for schools new to the *Everyday Mathematics* curriculum), and a parent handbook are being developed.

Everyday Mathematics for Grades 4–6

Extension of the *Everyday Mathematics* series through sixth grade was assured in September 1992, when NSF awarded the University of Chicago a five-year grant to support the preparation of materials for grades 4–6. With publication of the sixth-grade materials for the 1996–97 school year, UCSMP has completed its curriculum for elementary and secondary schools.

Input from field test teachers has played a crucial role in developing the program for grades 4–6. UCSMP field test teachers met regularly for training, review of materials, and discussion of experiences. Frequent contact was maintained through staff visits and through phone calls, and an Internet link with many field test teachers was established.

As the sequel to *Everyday Mathematics* for grades K–3, the 4–6 program builds on the experience with K–3, which has demonstrated that students of average ability can succeed in a more ambitious mathematics curriculum and maintain a high level of interest and enthusiasm, regardless of gender, race, community, or socioeconomic status.

The 4–6 curriculum emphasizes "mathematical modeling" of situations from everyday life and other school subjects. It blends mathematical strands (numeration, operations, geometry, measurement, data, and so on) with themes such as science, geography, sports, and architecture. For example, a fourth-grade unit on mammals develops skills and concepts of measurement, estimation, rates, and data analysis. In a year-long project for the same grade called World Tour, students "visit" a

variety of countries and collect and analyze information about them. Instruction blends exposition and discussion, individual and group work, and projects and investigations.

Calculators, manipulatives, and other tools are an integral part of the curriculum in grades 4–6. UCSMP recommends and provides materials for mid-unit, end-of-unit, cumulative, and ongoing assessment. Techniques include observation, portfolios, scoring rubrics, self-assessment, oral-and-slate questioning, and written assessments.

Each grade level includes a **Teacher's Manual and Lesson Guide** plus a **Teacher's Reference Book** with detailed information on mathematical content, classroom management, and other useful topics. **Student materials** include **journals**, booklets that provide lesson information, instruction, questions, and a permanent place to record conjectures and results; **MathLinks**, follow-up activities to be done in the classroom or at home; and a **reference book** and **student record book** for each of the year-long projects.

Our goal is that at least half of the students who complete *Everyday Mathematics* 4–6 be prepared to begin an algebra course in seventh grade, such as the second edition of UCSMP *Algebra*. The remainder will be well prepared for a course such as *Transition Mathematics*.

Everyday Learning Corporation

In 1989, Everyday Learning Corporation (ELC) in Evanston, Illinois, undertook commercial publication of *Everyday Mathematics* and *MathTools for Teachers*. To date, some 600,000 students across the country are using the K–5 materials already on the market.

ELC provides inservice training for users of *Everyday Mathematics*. Seven conferences held in the summer of 1995 provided inservice for about 2,400 people.

ELC also provides financial support for a variety of UCSMP development activities.

Teacher Development *Sheila Sconiers, Director*

With over 37 million students and 1.5 million teachers in U.S. elementary schools this year, staff development programs must expand beyond traditional limits. Addressing this "scale problem" for elementary mathematics education reform is a principal concern of UCSMP.

Over the past ten years, UCSMP has taken several approaches to this problem. One is a package of monthly workshops, first developed during the late 1980s and early 1990s, that enables classroom teachers to conduct staff development workshops for their colleagues and reduces the need for outside experts. Another approach is the UCSMP Mathematics Specialist Program, which prepares specialist teachers for mathematics in grades 4–6 and thus reduces the number of teachers needing staff development. A third approach to the scale problem is through teacher preparation programs. Over the years, UCSMP has surveyed these programs, sponsored conferences, and issued reports. Together, the Mathematics Specialist Program and the workshops provide plausible near-term solutions to the scale problem, while the investigations into teacher preparation programs seek answers for the longer term.

To date, UCSMP efforts have been aimed at teachers working with any elementary mathematics curriculum. Now, with the completion and widespread implementation of the *Everyday Mathematics* curriculum, UCSMP's elementary curriculum and teacher development efforts are more closely linked. Two UCSMP programs, one recently completed and the other currently under way, illustrate this linking of staff development and curriculum. Another project, not related to *Everyday Mathematics*, continues the investigations into teacher preparation programs.

Everyday Teaching for Everyday Mathematics K-3

UCSMP has recently completed *Everyday Teaching for Everyday Mathematics K–3*, a series of seven workshops, each about three hours long, for primary teachers of *Everyday Mathematics*. These workshops are designed to introduce the goals, philosophy, and mathematical foundations of *Everyday Mathematics* in a collaborative and reflective workshop setting. The *Everyday Teaching* series supersedes *MathTools for Teachers*.

Everyday Teaching is self-contained and trans-

portable, so that a school district's own training staff can conduct the program. The program is designed to be flexible: any subset of the workshops can be presented in any sequence. The workshops can be used as after-school workshops, as part of an inservice day, or as a week-long summer course. The *Everyday Teaching* package includes a **Staff Developer's Guide**, **Station Activity Sets**, and a **Mathematics Handbook**, a collection of six background essays for workshop participants.

The topics for the *Everyday Teaching* workshops are numeration and counting, plane geometry, measurement, operations, data analysis, solid geometry, and applications. *Everyday Teaching for Everyday Mathematics K–3* is published by the Everyday Learning Corporation.

Bridges to Classroom Mathematics

Bridges to Classroom Mathematics, a four-year NSF-funded project now in its second year, also addresses the problem of how to provide intensive staff development to thousands of teachers. Bridges is a collaboration between UCSMP and two Boston-area educational research and development organizations, the Consortium for Mathematics and Its Applications (COMAP) and TERC.

Bridges has two principal components: 1) the design of a staff development program and 2) the organization of two implementation centers for initial testing of that program.

Staff Development Program. Bridges aims to create materials that local school personnel can use to conduct staff development workshops for elementary school mathematics teachers. The materials will eventually support 90 hours of teacher workshops; the first 30 hours have already been written and field tested and are being revised. The materials will be arranged in 45 two-hour sessions. This modular arrangement will give teacher leaders and other staff developers the flexibility to tailor the program to their local needs and resources.

Some Bridges materials address the mathematics and pedagogy underlying all innovative programs based on the NCTM standards; other Bridges materials focus on the philosophy, goals, lesson formats, and so forth of a particular curriculum. Initially, two sets of curriculum-specific materials are being developed, one for UCSMP's *Everyday Mathematics* and one for TERC's *Investigations in Number, Data, and Space*.

Schools can use the generic Bridges materials even if they are not using *Everyday Mathematics* or *Investigations*. Other curriculum projects may find that they can create staff development programs by supplementing the generic materials with their own curriculum-specific materials.

The Bridges package for staff developers will include a **Staff Developer's Guide**, **Teacher's Handbook**, and **Video Library**. Both UCSMP's elementary materials publisher, the Everyday Learning Corporation, and TERC's publisher, Dale Seymour Publishing, will publish the Bridges materials.

Implementation Centers. To aid in the development, testing, and dissemination of the Bridges staff development units, the project has organized two implementation centers, one in Las Vegas and the other in Oakland County, Michigan. Each center has a Director and a group of Site Facilitators who are reform-oriented classroom teachers interested in providing staff development for their colleagues.

Over the next three years, the Site Facilitators will lead summer and academic-year pilot test workshops for teachers who are preparing to use either UCSMP's *Everyday Mathematics* or TERC's *Investigations*. During the summer of 1996, Oakland Site Facilitators conducted 30 hours of Bridges workshops for more than 50 elementary school teachers, and Las Vegas Site Facilitators conducted Bridges workshops for 90 teachers. During the 1996-97 school year, there will be follow-up workshops with many of these teachers and initial workshops for other teachers.

Several other school districts are also using the pilot Bridges materials. These secondary sites, together with the Implementation Centers, are the beginnings of a Bridges to Classroom Mathematics network that we hope will spread across the country, thus enabling new users to find experienced Bridges staff developers nearby and providing an effective response to the scale problem.

Study of the Mathematics Preparation of Elementary School Teachers

UCSMP and COMAP recently received a grant from NSF to examine the current state of elementary teacher preparation in mathematics. This grant, one in a series extending back to the early 1990s, will characterize preservice programs for elementary school mathematics teachers and will identify directions for future projects to help college mathematics faculty develop more effective programs for their own institutions.

Evaluation

Completed reports of many of these evaluations are available and may be ordered directly from UCSMP (see p. 19).

Materials Development

Kindergarten Everyday Mathematics was piloted in 1985-86 and revised prior to field testing in 1986-87. A formative study involving 17 classrooms in the inner city and suburbs of Chicago showed that students substantially improved their mathematics skills, with student performance comparing favorably to that in a previous study of counting, numeration, and operations abilities. Improvement was particularly apparent in urban classes. Inner-city children who did about half as well as suburban children on a variety of mathematics tasks at the beginning of the year did 80% as well as their suburban counterparts at the end of the year.

Field test teachers reported that their students took more responsibility for their own mathematics learning, that small-group activities encouraged cooperative learning, and that projects and explorations provided challenges for children of varying abilities in the same classroom. Developers revised *Kindergarten Everyday Mathematics* again on the basis of field test results prior to publication.

Evaluation of subsequent years of the *Everyday Mathematics* curriculum has proceeded similarly. Formative evaluation of field test materials was the basis for the published versions of the curriculum for grades 1–5.

Results from the grades 4 and 5 field tests and related studies indicate that *Everyday Mathematics* students do as well on computation and much better in areas traditionally underrepresented in the elementary school curriculum, such as mental computation, geometry, data and graphing, and fractions.

Study teachers indicate that students are much better at reasoning, problem-solving, and communication, and show a better mathematical understanding than students of previous years. Teachers also rate the curriculum highly on meeting the goals of the NCTM standards.

In October 1993, NSF authorized adding a longitudinal study of K–4 *Everyday Mathematics* to the project. Researchers have been interviewing and testing a cohort of *Everyday Mathematics* students since first grade. Along with collecting data on the students, in the third grade in 1995-96, researchers observed classrooms and interviewed teachers to help identify ways of implementing, supporting, and sustaining reform.

Teacher Development

MathTools for Teachers, the UCSMP program for primary teachers, was systematically and extensively evaluated in 1985-86. The study found that teachers responded positively to the workshops, increasing their mathematics instruction time incrementally during a period of heavy information accumulation and assimilation. Teacher networks were less successful due to factors such as lack of time. In 1986-87, UCSMP evaluated one aspect of the program, calculator usage by the K–3 teachers after their workshop training. Students and teachers enjoyed using calculators, and nearly half the teachers reported using them often. Teachers saw improvements in student achievement, motivation, mathematical confidence, attitudes, and accuracy.

In 1987-88, UCSMP conducted a study of the Mathematics Specialist Program in grades 4–6. To describe and document the implementation of math specialists in the six participating elementary schools, teacher development staff observed classes, while evaluation staff focused on the structural, organizational, and social implications of the program. In 1988–89, evaluators surveyed participants in the program informally, assessing their adjustment to the specialist role. Of interest was the reorganization of each school to allow for content specialization and its impact on the students, teachers, and administrators.

Although many organizations have recommended the use of calculators in mathematics classes from kindergarten on, there has been very little research to determine the effects of calculator use on students in grades K–2. In 1988–89, a calculator study was conducted in 36 first- and second-grade classes in the Chicago area. Experimental classes used the UCSMP calculator curriculum materials. Pretests and posttests were administered and were supplemented by classroom observations and interviews with teachers and students.

Secondary Component

Zalman Usiskin & Sharon Senk, Co-Directors

Materials Development

Since 1980, reports from national commissions have identified major problems in performance and curriculum in pre-college mathematics: high school students currently are not learning enough mathematics; school curricula have not kept pace with changes in mathematics, its applications, and technology; *all* students need to learn significant amounts of mathematics. These reports have produced a broad consensus on the changes needed in mathematics instruction, a consensus reflected in the NCTM standards documents.

From 1983 to 1991, the UCSMP Secondary Component developed a six-year mathematics curriculum for students in grades 7–12 in line with this consensus. Since 1992, the component has worked on the second editions of these materials. The UCSMP curriculum transforms high school mathematics into a mathematical sciences curriculum, covering a much greater range of material important for life in a technological society while maintaining consistency with recent developments in college-level mathematics. This curriculum targets the general school population—students who will graduate high school—and conveys the essential role of mathematics in everyday life by teaching students to use mathematics effectively.

Elements of the Secondary Curriculum

Several basic elements distinguish UCSMP texts from most existing texts:

• **Wider Scope** Geometry, algebra, and some discrete mathematics occur in all courses. Statistics and probability are integrated into the study of algebra and functions. All courses discuss the history of major ideas and recent developments in mathematics and mathematical applications.

• **Reading and Problem-Solving** Each lesson includes selections for students to read and contains questions and problem sets applying the reading. The text informs students about the selection of problem-solving methods, the history and application of ideas, and the relations between concepts.

• **Applications** Students study each mathematical idea through its application to practical problems, providing many opportunities for the development of skills and an understanding of the importance of mathematics in everyday life.

Every high school graduate should take the first four courses in the UCSMP secondary curriculum, all college-bound students the first five, and all students who might study technical subjects all six courses or their equivalent.

• **Use of Technology** The emphasis on everyday mathematics applications extends to the approaches for solving problems. Students are expected to have scientific calculators in all courses. Automatic graphers are used beginning in UCSMP *Algebra* and assumed to be available daily in the last three courses. Automatic drawers are recommended for use with UCSMP *Geometry*. Calculators or computer software that does statistics is required for the fifth course.

• **Multidimensional Approach to Understanding** All texts emphasize skill in knowing how and when to use various algorithms, properties and mathematical relationships, realistic uses of ideas encountered, and the representation, or picturing, of mathematical concepts. This is the SPUR approach—emphasizing *S*kills, *P*roperties, *U*ses, and *R*epresentations.

• **Instructional Format** The materials maximize learning by featuring continual review, combined with a modified mastery learning strategy. The questions at the end of each

lesson include review of previous lessons. At the end of each chapter are a summary, a self-test to assess progress toward mastery, and review questions keyed to objectives.

Projects In the last two courses of the first edition and in all second-edition courses, a selection of student projects is offered for each chapter. These projects offer the opportunity for students to spend a few hours or days exploring a topic in depth and writing about it for others to see or hear.

Secondary Curriculum Outline

Extensive testing verifies that the average to above-average student can begin this curriculum in the seventh grade and proceed with one course a year through twelfth grade. Schools that have a strong K–5 curriculum like UCSMP *Everyday Mathematics* have found that they can begin this curriculum in the sixth grade.

By starting earlier or later, or taking the first two courses at a somewhat slower pace, the curriculum sequence can accommodate a wider range of students. It was originally thought that *Transition Mathematics* would be used only in grades 6–9, but in actuality, classes in grade 5 through developmental courses at the college level are currently using the text. A student may take *Transition Mathematics* in ninth grade and still complete a high school mathematics sequence through *Advanced Algebra*. UCSMP's goal is to have every high school graduate take the first four courses, all college-bound students take the first five, and all students who may study technical subjects take all six courses, or their equivalents.

Transition Mathematics (Year 1) This course weaves together three themes—applied arithmetic, pre-algebra, and pre-geometry—by focusing on arithmetic operations in mathematics and the real world. The course introduces algebra by examining three uses of variables (pattern generalizers, abbreviations in formulas, and unknowns in problems) and variable representation on the number line and coordinate plane. The course also introduces basic algebra skills and connects geometry to arithmetic, measurement, and algebra.

Algebra (Year 2) UCSMP *Algebra* has a scope far wider than traditional algebra books, highlighting applications, using statistics and geometry to develop the algebra of linear equations and inequalities, and including probability concepts in conjunction with algebraic fractions. Applications motivate virtually all lessons. Considerable attention is given to graphing. Manipulation with rational algebraic expressions is delayed until later courses.

Geometry (Year 3) UCSMP *Geometry*, diverging from the order of topics in most geometry texts, presents coordinates, transformations, measurement formulas, and three-dimensional figures earlier in the year. To teach writing proofs and other mathematical arguments more effectively, the course lays a foundation of prerequisite understanding step by step. Again, applications abound throughout.

Advanced Algebra (Year 4) This course emphasizes facility with algebraic expressions and forms, especially linear and quadratic forms, powers and roots, and functions based on these concepts. Students study logarithmic, trigonometric, polynomial, and other special functions as tools for modeling real-world situations. The course applies geometrical ideas learned in the previous years, including transformations and measurement formulas.

Functions, Statistics, and Trigonometry (Year 5) Students study descriptive and inferential statistics, combinatorics, and probability, and do further work with polynomial, exponential, logarithmic, and trigonometric functions. Enough trigonometry is available to constitute a standard precalculus background in trigonometry and circular functions. Algebraic and statistical concepts are integrated throughout, and modeling of real phenomena is emphasized. Students use a function grapher and a statistical utility to study functions, explore relationships between equations and their graphs, analyze data, and develop limit concepts.

Precalculus and Discrete Mathematics (Year 6) Precalculus topics include a review of the elementary functions, advanced properties of functions (including special attention to polynomial and rational functions), polar coordinates, complex numbers, and introductions to the derivative and integral. Discrete mathematics topics include recursion, induction, combinatorics, vectors, graphs, and circuits. Manipulation of rational expressions is discussed here. Mathematical thinking, including specific attention to formal logic and proof and comparing structures, is a unifying theme throughout.

Development

The Secondary Component developed each first-edition course in stages spanning four or five years. During the **planning stage**, UCSMP created overall goals, both in consultation with a national advisory board of distinguished mathematics educators and through discussion with classroom teachers, school administrators, and district and state mathematics supervisors.

At the **pilot stage**, UCSMP selected authors to write first drafts of the courses. Half of all UCSMP authors currently teach mathematics in secondary schools, and all of the authors and editors for the first five courses have had secondary teaching experience. Authors or their surrogates taught the first drafts of the texts themselves, so their subsequent revision benefited from first-hand classroom experience.

After revision by the authors and editors, materials entered the **formative stage** of course development. More classes used the books and independent evaluators closely monitored student achievement and attitudes, as well as issues related to implementation. Teachers met periodically at the university to provide feedback to the UCSMP staff for a second revision.

For the first three books, the Carnegie Corporation of New York funded large national studies assessing student and teacher performance and comparing UCSMP courses with traditional mathematics curricula; final revisions were based on the findings of these studies. The last three books went through formative evaluations.

Planning, writing, and field testing of UCSMP second editions began with *Transition Mathematics* and UCSMP *Algebra* in 1992 and continued with UCSMP *Geometry* and UCSMP *Advanced Algebra* in 1993. The second edition of *Transition Mathematics* appeared in 1994, UCSMP *Algebra* and *Advanced Algebra* in 1995, and UCSMP *Geometry* in 1996. Work is underway on the second editions of *Functions, Statistics, and Trigonometry* and *Precalculus and Discrete Mathematics*, and publication is expected in 1997. See p. 18 for some of the changes made in the second editions.

All secondary textbooks and a complete set of supporting materials are available from Scott Foresman/Addison Wesley.

Teacher Development

The elements distinguishing UCSMP texts from most others—wider scope, an emphasis on reading and problem-solving, many more applications, the use of technology—have obvious implications for the way mathematics should be taught. The Secondary Component has engaged in intensive efforts in the area of teacher development.

Institutes

The project received funding in 1989 from the Ford Motor Company for five UCSMP Secondary Summer Institutes, held in 1989-92. For two weeks each institute brought together 25 university educators, secondary supervisors, and teachers in leadership positions chosen from a nationwide pool of applicants. They attended sessions focusing on new content (including applications, modeling, statistics, discrete mathematics) and new approaches (problem-solving and understanding, careful development of geometry and proof), as well as technology workshops and discussion groups.

To facilitate the transmission of new ideas to teachers across the country, while at the University of Chicago participants developed plans for further dissemination tailored to the particular situation in their own districts.

Workshops

Held annually in August since 1989, these day-long workshops are open to all those who will be teaching or supervising the teaching of UCSMP secondary materials during the upcoming academic year. Participants register for an entire day devoted to one of the texts. Following an overview of the secondary curriculum, the day consists of sessions led by UCSMP authors and experienced teachers, who provide detailed information about teaching from the text, offer advice, and answer questions. In 1996, over 400 teachers attended these workshops.

Conferences

Since 1985, the Secondary Component has hosted a November conference at which both current and prospective users of project materials can learn more about UCSMP. The conference

includes users' sessions offering teachers an opportunity to share experiences and ideas with their peers, overviews of each text presented by UCSMP authors and experienced teachers, sessions on teaching each book as described for the workshops, and many other sessions on issues related to using UCSMP materials. In 1995, over 600 people attended. The 1996 conference is being held November 9–10. Scott Foresman/Addison Wesley sponsors several regional user conferences. For more information, contact UCSMP.

Evaluation

There is room here for only a brief summary of the evaluations of secondary materials. A longer summary is found in the Teacher's Edition of each book. Full reports of some of these evaluations are available (see p. 19). Final reports for the second editions should be available in the near future.

First Editions

In 1985-86, a large matched-pair, nationwide study compared *Transition Mathematics* with standard texts used in 7th-, 8th-, and 9th-grade classes. UCSMP students significantly outperformed comparison students in geometry and algebra readiness and became effective calculator users with no loss of arithmetic skills. Teachers reported that although at first many students did not do the desired reading, the situation improved as the year went on.

In 1987-88, a similar study was conducted on UCSMP *Algebra*. UCSMP and comparison students did equally well on a standardized algebra posttest. UCSMP students outperformed comparison students in every area on two other tests of nontraditional and traditional concepts and skills. *Algebra* teachers, enthusiastic about its applications, rated the text highly and were successful in getting students to read.

National field testing of *Geometry* began in 1987-88. UCSMP students scored significantly higher than comparison students on a content-specific test of reasoning, transformations, visualization, coordinates, applications, and standard geometry. A second national field study in 1988-89 focused on *Geometry* students with previous UCSMP experience. One new finding was that teaching such students was easier; classes in which 80% of the students had taken previous UCSMP courses began the year expecting to do a lesson a day, completing all the questions and engaging actively in class discussion.

The last three texts in the secondary curriculum went through two years of pilot testing followed by a formative evaluation. Studies included observations, interviews, and testing with multiple-choice and open-ended items. In 1987-88, UCSMP *Advanced Algebra* underwent formative evaluation. Analyzed according to UCSMP's SPUR dimensions of understanding, the posttest showed UCSMP students answering correctly 15.6% more questions than comparison students and outperforming their counterparts by more than 20% on a variety of common advanced algebra problems.

During 1988-89, *Functions, Statistics, and Trigonometry* underwent a formative evaluation, and in 1991 the multiple-choice part of the posttest was repeated in the same schools. In both cases, UCSMP students outperformed the U.S. sample of precalculus students in the Second International Mathematics Study (SIMS) on items involving statistics and probability, with the sample outperforming UCSMP students on items covering polynomial and rational functions. The text was revised to include more on polynomial functions.

During 1989-90, *Precalculus and Discrete Mathematics* underwent formative evaluation in nine schools across the country. Part of the posttest was repeated in 1991 in six of these schools. On standard precalculus content, such as functions, trigonometry, and limits, UCSMP students significantly outperformed the SIMS precalculus students. UCSMP students were quite successful at proving trigonometric identities, moderately successful with number theory proofs, and not very successful at proofs using mathematical induction.

A longitudinal study of the first cohort to complete the first four UCSMP texts was done in 1989-90 at two suburban and one urban site. UCSMP students significantly outperformed carefully-matched comparison students on traditional tests at two of the three sites and on

applications at all sites. At one suburban site, UCSMP students significantly outperformed students a year older (in comparable courses) on applications and did as well on traditional tests; at the other, older comparison students did as well as UCSMP students on applications and significantly better on traditional tests.

Second Editions

The evaluations that led to the second editions can be said to have begun before their writing. A large sample of users was selected for each course and asked for comments about each lesson in the student text and about the various materials available with the text.

Their recommendations led to several major revisions in all the books. Projects were written for each chapter. Also included were reading heads to organize each lesson, in-class activities to introduce selected lessons, and activities within lessons—all making it easier for students to read the lessons and become more active learners. A double set of Lesson Masters was made available.

Recommendations relevant to specific courses also were made, often motivated by the desire to ensure that material in the books' last few chapters would be reached. First-edition as well as new authors were brought in to write. The materials, edited by UCSMP, were distributed to schools during the next school year.

Evaluations were directed by an experienced researcher brought in expressly for this purpose. Schools and classes were chosen from around the nation to reflect the wide range of students using UCSMP materials and for their likelihood of obtaining matching comparison classes. In every matched pair, the two classes had to be from the same school. Most comparison classes used first-edition UCSMP materials. We believe this is the first time a curriculum has been carefully compared with a previous version of itself. Other comparison classes used non-UCSMP materials, providing a replication of first-edition studies.

Transition Mathematics was so well liked by teachers that no major changes were made in its structure. Still, large numbers of smaller changes were made. Although teachers in these classes who had taught both first- and second-edition materials unanimously preferred the second edition, there were no statistically significant differences between the performance of first- and second-edition students. All four UCSMP second-edition classes were equal to their non-UCSMP counterparts on general mathematics, two classes outperformed their non-UCSMP counterparts on the algebra posttest, and three classes outperformed their non-UCSMP counterparts on the geometry posttest. These results confirm the results of the first-edition studies.

A major change in the structure of UCSMP *Algebra* for the second edition was to shorten the review of ideas found in the preceding book and to begin equation-solving with equations of the form $ax = b$ rather than with equations involving addition. Other changes included an earlier introduction of quadratic equations and a more intense development of factoring. There were no significant differences among students in the sixteen pairs of classes in which the comparison class used first-edition UCSMP materials. In the four pairs of classes in which the comparison classes used non-UCSMP materials, the UCSMP students were equal on a standardized algebra test and significantly outperformed their counterparts on tests of a wider range of algebra and problem-solving.

No major changes were made in the structure of UCSMP *Geometry* for the second edition, although some chapters were reordered. Second-edition UCSMP students outperformed their first-edition counterparts on both a standardized geometry test and a second test with broader geometry content. This may be because they were more likely to find their textbook easy to read and interesting or because the more active approach and projects benefit geometry students more than students in other courses. Second-edition UCSMP students performed as well as their non-UCSMP counterparts on the standardized test and scored much higher on the broad-based test.

A major change in the second edition of UCSMP *Advanced Algebra* was to require the use of automatic graphers and begin the study of functions in the first chapter. This enabled new lessons on modeling using linear, quadratic, and exponential functions. Content in other chapters was reordered. Standardized tests appropriate to the content of this book do not exist, so we designed multiple-choice and problem-solving posttests. On these tests, there were no significant differences between first- and second-edition students. There were large significant differences favoring second-edition UCSMP students over their non-UCSMP counterparts on both tests.

Available Materials

Elementary Materials available from Everyday Learning Corporation

Kindergarten Everyday Mathematics
First Grade Everyday Mathematics
Second Grade Everyday Mathematics
Third Grade Everyday Mathematics
Fourth Grade Everyday Mathematics
Fifth Grade Everyday Mathematics
Sixth Grade Everyday Mathematics
Everyday Teaching K–3
Do Elephants Eat Too Much?
If I Walk in the Woods, Will I Run into a Bear?
From the Seas to the Stars
From Your Backyard to the Great Wall
Calculator Mathematics 1
Calculator Mathematics 2

*Secondary Materials available from Scott Foresman/Addison Wesley**

Transition Mathematics
UCSMP Algebra
UCSMP Geometry
UCSMP Advanced Algebra
Functions, Statistics, and Trigonometry
Precalculus and Discrete Mathematics
GeoExplorer
GraphExplorer
StatExplorer
Wide World of Mathematics

*Each text has student and teacher editions, ancillary materials, and software.

Resource Materials available from the UCSMP Director's Office

Soviet Studies in Mathematics Education, vols. 7-8
Japanese Grade 7 Mathematics
Japanese Grade 8 Mathematics
Japanese Grade 9 Mathematics
Russian Grade 1 Mathematics
Russian Grade 2 Mathematics
Russian Grade 3 Mathematics

Resource Materials available from the American Mathematical Society

Mathematics 1: Japanese Grade 10
Mathematics 2: Japanese Grade 11
Algebra and Geometry: Japanese Grade 11
Basic Analysis: Japanese Grade 11

Resource Materials available from the National Council of Teachers of Mathematics

Developments in School Mathematics Education Around the World, vols. 1–3
Soviet Studies in Mathematics Education, vols. 1–6

Evaluation Reports available from the UCSMP Director's Office

Elementary

An Evaluation of the Teacher Development Project, 1985-86
Formative Evaluation of Kindergarten Everyday Mathematics
A Follow-up of Kindergarten Everyday Mathematics Users
The Ray School Computer Lab: Evaluation Report, 1985-86
Calculator Usage in the Teacher Development Project
Mathematical Knowledge of Kindergarten and First-Grade Students in Everyday Mathematics
Classroom Implementation and Impact of Everyday Mathematics K–3: Teachers' Perspectives on Adopting a Reform Curriculum
A Field Test of Fourth Grade Everyday Mathematics, 1993-94 *(complete & summary reports)*
Third Grade Everyday Mathematics Students' Performance on the 1993 and 1994 Illinois State Mathematics Test
Report on the Field Test of Fifth Grade Everyday Mathematics

Secondary

Transition Mathematics Field Study
Teaching and Learning Algebra: An Evaluation of UCSMP Algebra

Evaluation Reports available from UMI Dissertation Services

An Evaluation of a New Course in Precalculus and Discrete Mathematics
Implementation of the First Four Years of the University of Chicago School Mathematics Project Secondary Curriculum

See back cover for addresses.

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UCSMP Directory

At 5835 S. Kimbark Avenue, Chicago, IL 60637:

Director's Office

Zalman Usiskin, Director (773) 702-1560
Carol Siegel, Assistant to the Director (773) 702-9770

Elementary Component

Max Bell, Director (773) 702-1563
Sheila Sconiers, Director of Teacher Development (617) 862-7878
COMAP, Inc., 57 Bedford St., Suite 210, Lexington, MA 02173

Secondary Component

Zalman Usiskin, Co-Director (773) 702-1560
Sharon Senk, Co-Director (517) 353-4691
Mathematics Department, Wells Hall, Michigan State University, East Lansing, MI 48824

Evaluation Consultant

Larry Hedges (773) 702-1589

At 5734 S. University Avenue, Chicago, IL 60637:

Resource Development Component

Izaak Wirszup, Director (773) 702-7397

UCSMP Past Director, 1983–87

Paul Sally (773) 702-7388

Publishers of UCSMP Materials

Everyday Learning Corporation (800) 382-7670
P.O. Box 812960
Chicago, IL 60681

Scott Foresman/Addison Wesley (800) 554-4411
1900 E. Lake Avenue
Glenview, IL 60025

National Council of Teachers of Mathematics (703) 620-9840
1906 Association Drive
Reston, VA 22091

UMI Dissertation Services (800) 521-0600
300 N. Zeeb Road
Ann Arbor, MI 48106

American Mathematical Society (800) 556-7774
P.O. Box 6248
Providence, RI 02940-6248

Other materials are available directly from the UCSMP Director's Ofice.